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A TYPE CASE IN DIVERSION OF DRAINAGE*

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IN regions that have once been glaciated we find many interesting drainage problems. While the general topography of northern North America may have been but slightly altered by the ice invasion, the courses of many streams have suffered change. Particularly is this noticeable in present divide areas, and in sections where thick deposits of moraine have accumulated. When a mass of moraine was laid across the valley of even a well developed river, the waters were often obliged to seek another outlet. The position of the new outlet was determined largely by the relation of valleys already existing to a divide that yielded most readily to agents of erosion. The normal river piracy that may be observed in water-parting regions of unglaciated lands would be accentuated by an Ice Age; for ice erosion, and ice front drainage, would hasten the cutting down of narrow barriers remaining between the extreme tributaries of separate systems. The southern arms of the St. Lawrence basin have been shortened through the interference of glacial deposits and the northern tributaries of the Susquehanna and Ohio Rivers have encroached in New York and Pennsylvania on the Laurentian system, as is shown by several instances that have been investigated.†

In the glaciated states there is scarcely a county in which a stream has not undergone some abnormal alteration, though the change may be slight, such as the mere removal or addition of a few miles to the headwaters of the stream. A type case in such diversion of drainage is here

*This paper is work done under the direction of Professor R. S. Tarr, at Cornell University, as a partial requirement for the degree of Ph. D.

† Carll, Second Geological Survey—Penn., III., 1880, 330–366. Chamberlin and Leverett, *American Journal of Science*, Series III., XLVII., 1894, 247–283. Tarr, *The Physical Geography of New York State*, 167–172.

XUM

described for the purpose of suggesting to grammar and high school teachers the possibility of investigating similar cases in their own localities.

NORMAL RIVER DEVELOPMENT

For a better understanding of the phenomena to be considered, we will briefly review the development of a drainage system. Given a region in youth,* the rocks being of uniform texture, the first streams are simple, each having a single valley. Then lateral streams appear; the valley of the parent river grows longer and broader. The original lateral arms become the parent streams of secondary branches; ultimately a river system is produced. The valley of the parent stream is widest where it approaches the sea, or the body of water into which it empties; the original lateral streams widen as they approach the major streams; while the valley of each sub-arm is broadest at its point of union with a larger arm of the system. The eroded material is carried seaward. As down-cutting progresses, the slope of the stream bed decreases, and a part of its

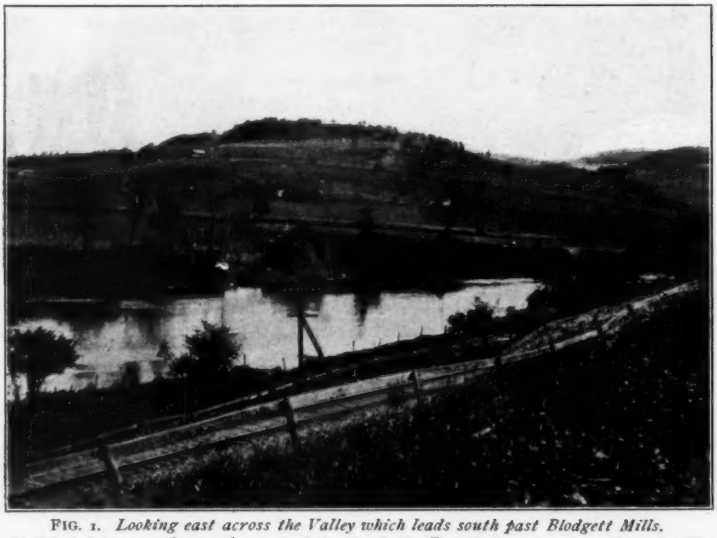


FIG. 1. *Looking east across the Valley which leads south past Blodgett Mills. At this point, some three miles east of Cortland, the Tioughnioga turns southward. The stream is here running near the western wall of the valley. The width of the valley bottom and the rather gentle slope of the walls show maturity.*

* Gannett, *Topographic Atlas of the U. S.*, Folio 1.

FIG. 2. *Looking northward from Messengerville.*
This picture was taken from a spur at the foot of which is the village; the wall directly east is cliff-like. Had the camera been near the axis of the valley, the two profiles in the distance would interlock. Opposite each of these spurs is a steep cliff.

load is deposited in the lower reaches of the river where aggrading or upbuilding commences. Such a condition is usually marked by a broad valley with a meandering stream. The water in every part of the system flows in the direction in which the valleys broaden.

Furthermore, note in particular two points always observed in normal drainage of regions with uniform texture of rocks: (1) the valleys narrow toward divide areas, (2) the water flows contrary to the direction in which the valleys narrow. In general, at every stream juncture the land surface has been cut into two unequal angles, the smaller of which points down stream; *i. e.*, the land surface of the drainage basin has been dissected into irregular blocks whose longer axes converge towards the original stream valley.

DESCRIPTION OF FALL CREEK REGION

The map, page 113, is of a region drained at present by a tributary of the Susquehanna. The region is a part of the St. Lawrence-Susquehanna divide area, which has a general altitude of about 2,000 feet. The "Finger Lakes" lie to the west and northwest. The moraine of the "second glacial epoch"* stretches across the region under consideration. To the

*Chamberlin, U. S. G. S., Third Annual Report.

north are comparatively short streams draining into the Ontario basin; the area to the east is drained by the Chenango, another tributary of the Susquehanna. A sufficient number of contours are given on the map to show that the region is quite mature in its drainage development.* The question involved can be more easily understood by having at hand the following United States topographic sheets: Dryden, Moravia, Cortland, Harford, Pitcher and Cazenovia.

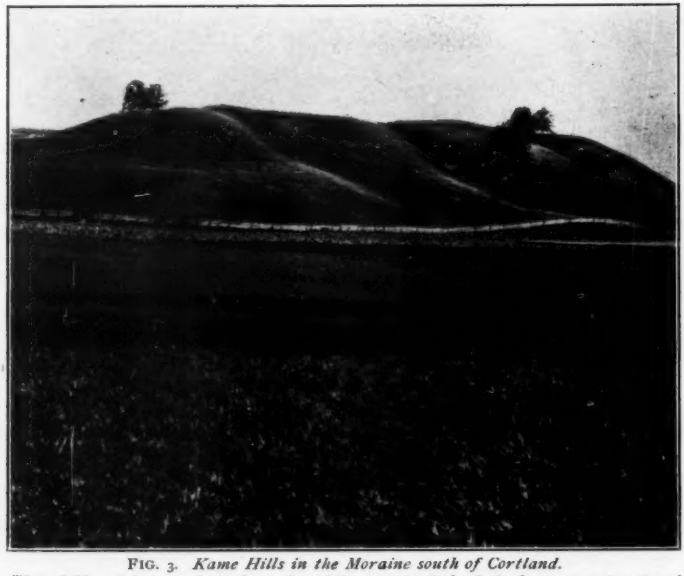


FIG. 3. *Kame Hills in the Moraine south of Cortland.*
These hills, rising 140 feet above the plain, are typical of the kame-moraine found throughout the Cortland-Freeville Valley.

The Tioughnioga River has three arms which meet near Cortland. The valley of the West Branch, flowing southward past Homer, is broad and mature; the East Branch, coming from north of Deruyter, is also in a mature valley, which broadens continually as it flows southward past Truxton and East Homer; Trout Brook, rising east of Solon, flows nearly due west and meets the Tioughnioga in a broad overwash plain (see Figure 5) east of Cortland. A most obvious fact about these arms is that they all broaden towards Cortland, where the valley is over a mile wide. From Cortland the Tioughnioga flows in an eastern direction for about

* Gannett, *Topographic Atlas of the U. S.*, Folio 1.

three miles; then the stream turns southward (see Figure 1), passing Blodgett Mills and Marathon, and joining at Chenango Forks a tributary of the Susquehanna.

The Blodgett Mills Valley, at its junction with the east-west valley, is one-half mile wide; at Blodgett Mills the valley is one-quarter mile wide; it continues to narrow southward, having for some miles a width of from thirty to sixty rods. In this narrow section are perpendicular rock-walls produced by under-cutting of a meandering stream. In the vicinity of Messengerville the valley is more mature and commences to broaden again. (See Figure 2.) A study of the lateral streams of this valley shows (1) that for three miles south of Blodgett Mills they meet the parent valley, forming angles, the smaller of which point northward; (2) that for the next two miles or more there are no well formed lateral valleys; (3) that thence southward the side streams meet the main valley, forming angles, the smaller of which point to the south; (4) and that these lateral valleys now have streams which, before meeting the north-south valley, flow for some distance through rock walls, and have, in some instances, cascades, in others perpendicular falls, thus showing rejuvenation.

EXPLANATION

What probable explanation is there for the condition of affairs existing in the Blodgett Mills-Marathon Valley? Three sections of this valley are indicated on the map by A, B and C, respectively. B may have been a pre-glacial divide area; the stream in A then drained northward, as indicated by the angles of the lateral valleys, and was a tributary of the stream flowing westward from Solon; evidence of the same nature indicates that C drained southward by a stream passing Marathon, and belonging to the Appalachian drainage system. These two pre-glacial streams occupying valleys broadening in opposite directions belonged evidently to separate river basins. The narrow divide B was cut down; the drainage from the north then took its present course.

At Cortland the Tioughnioga receives from the south Otter Creek, which heads about two and one-fourth miles northeast of McLean; this creek, an insignificant stream, flows east of north in a valley one and one-fourth miles wide; its divide is in a moraine area dotted with kettle lakes. Flowing southwest from the same area is Beaver Brook, a branch joining Fall Creek south of McLean. Fall Creek rises some ten miles north of McLean; from McLean it flows in a general southwest direction, emptying into Cayuga Valley at Ithaca. Two branches, the Dryden and Groton

XUM

FIG. 4. *Eastern part of an Esker northeast of Freeville.*
The height of the esker is from 20 to 30 feet, while the slope of its sides is from 16° to 25°. The wooded area marks the location of a morainic kettle which is now nearly filled by the encroachment of vegetation.

arms, join Fall Creek Valley near Freeville, where the valley has a width of nearly two miles.

Thus it appears that the Tioughnioga, through its several branches, drains an area north and northeast of Cortland; that these branches flow in valleys one-half to one mile wide; that these valleys gradually broaden toward Cortland; and that they dissect the area into blocks, whose longer axes point in the direction of Freeville. But instead of flowing southwest from Cortland, the river turns eastward, then south, entering and flowing through a valley in the same direction in which the valley narrows. From a few miles north of Marathon the river continues southward in a valley which broadens in that direction.

We have, therefore, this abnormal condition of drainage: (1) a river for more than twenty miles meanders in a mature valley which attains a width of one and one-fourth miles, then for ten miles it flows through a narrow valley having a maximum width of one-fourth mile; (2) the United States topographic sheets show a mature valley of one and one-

fourth miles minimum width and ten miles long extending from Cortland to Freeville; the side walls of this valley have gentle slopes blending into the valleys coming together at Cortland. The valley from Cortland to Freeville continues with normal increase in width and gradient to Ithaca. The streams now flowing in the Cortland-Freeville Valley, aided by all the valley-making agents recognized, could not have produced the valley in its present condition; furthermore, the gently sloping side walls are continuous, evidently the product of a single river rising many miles to the north. But the valley is now drained in two directions: towards Cortland by Otter Creek, and to Ithaca by Fall Creek.

In the presence of these facts, one naturally inquires whether the drainage from Homer, Deruyter and Solon should not come normally by way of McLean and Freeville into Cayuga Valley? If the Blodgett Mills outlet for the drainage north and northeast of Cortland is abnormal, what has caused the diversion?

Early in this paper it is mentioned that the moraine of the "second glacial epoch" crosses the region we are studying. This moraine is extremely well developed between Freeville and Cortland. Just north

FIG. 5. *The Overwash Plain east of Cortland, looking a little north of west. The gently sloping side walls show the maturity of the valley. The dim sky line is the west wall of the Cortland-Freeville Valley. The meandering stream is Trout Brook, which joins the Tioughnioga one-half mile to the south.*

FIG. 6. *Kettle Lake in the Moraine of the Cortland-Freeville Valley.*

of Freeville is a marked kame area*; other kame areas of almost equal proportions are found on the west side of the valley south of McLean, and on the east side south of Cortland. (See Figure 3.) Two miles northeast of the first kame area is a beautiful esker. (See Figure 4.) The Cortland-Freeville Valley throughout its whole extent presents moraine topography; a tongue from the ice front persisted here long enough to plug the old valley quite full; it is not a case in which a dam has been built across the valley by a single crescentic moraine loop, marking the position maintained for some time by an ice tongue. Possibly a detailed study of this moraine accumulation will show a series of such loops blended and knit together by a variety of overwash and kame deposits. Well borings at Freeville have gone through 250 feet of glacial materials without reaching the rock floor of the valley; both here and at Cortland the streams from the ice front were so loaded by debris that the valley has been leveled up with overwash plains (see Figure 5), thus giving the valley an appearance of somewhat greater maturity than

* For a view of this, see Tarr, *The Physical Geography of New York State*, Fig. 68.

normally belongs to it. The depth of this drift filling can be ascertained only by borings; north of Freeville, no well deeper than seventy-five feet has been sunk. Between McLean and Cortland are many kettle lakes (see Figures 6 and 7); in some of the partially filled kettles, marl is found.*

It seems evident then that this valley was so blockaded by moraine and wash deposits that the normal drainage has suffered a reversal. Looking at a map made by assembling the contour sheets of the region, one is struck by the alignment of Fall Creek Valley with the valleys that come together at Cortland. One doubts whether Fall Creek, with its present length and volume, could, in any geological time, have carved the wide mature valley in which it flows; but by giving to this stream the drainage basin of the Tioughnioga, one can understand the maturity of the valley. In pre-glacial times, West Branch and Trout Brook were tributaries of Fall Creek, which had its headwaters north and east of Deruyter. A discussion of the further conditions which figured in the

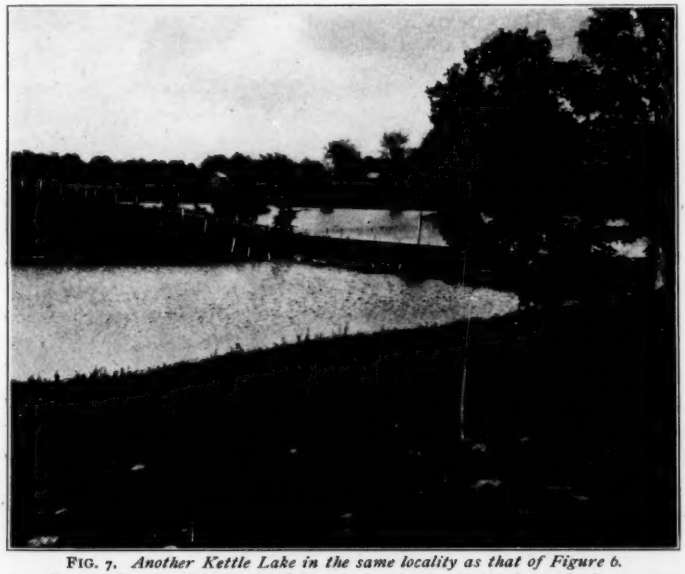
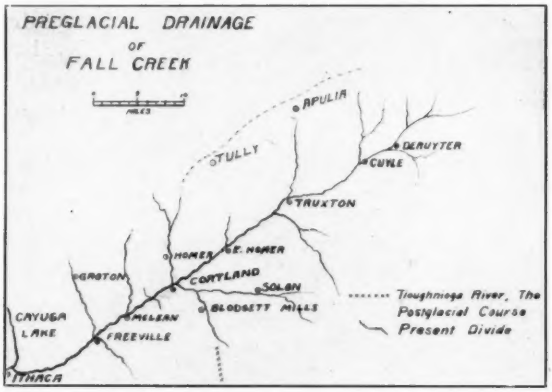


FIG. 7. *Another Kettle Lake in the same locality as that of Figure 6. A railroad filling has divided this lake into two parts. In the foreground are many well rounded glacial pebbles.*

* Tarr, *The Physical Geography of New York State*, 203.

establishment of the Blodgett Mills outlet for the drainage that once belonged to Fall Creek would lead this paper beyond its initial purpose, *i. e.*, of describing a type case in river diversion, which might be an incentive to the study and recording of similar instances.



THE CHINOOK WINDS*

BY ALVIN T. BURROWS,
Observer, Weather Bureau

ORIGIN of the Application of the Name "Chinook" to Winds.—At the present time there are three different winds called Chinooks. Each of them is essentially a warm wind, whose effect is most noticeable in winter. Under their influence snow is melted with astonishing rapidity and the weather soon becomes balmy and spring-like. The name "Chinook" is that of an Indian tribe which formerly lived near the mouth of the Columbia River. It was first applied to a warm southwest wind which blew from "over Chinook camp" to the trading post established by the Hudson Bay Fur Company, at Astoria, Oregon. The name soon came into general use in that locality, and as the adjacent country was settled the usage extended, so that now "Chinook" is applied not only to the warm, moist southwest winds along the Oregon and Washington coast, but to the warm, dry, descending winds east of the

*Reprinted by special permission from the Department of Agriculture Year Book, 1901.

Cascade range in Washington and the Rocky Mountains in Montana and elsewhere. In 1895 Mr. B. S. Pague, the local forecast official at Portland, Oregon, began to call the descending southwest winds that visited western Oregon and Washington during the winter "Chinooks."

Wet and Dry Chinooks.—The warm, wet Chinook of the Pacific Coast was for many years supposed to owe its existence to the Japan Current, over which it was thought to blow. This is still the popular belief in many localities where the wind occurs. Scientific investigation has shown the fallacy of this view. The Japan Current is but a small fractional part of the Pacific Ocean and its influence is correspondingly small. Its effect, if any, on the wind would be lost, as this current does not approach within 1,000 miles of the Puget Sound country. The relative warmth of the ocean over which the winds must blow is itself a sufficient cause of any relatively high temperature accompanying the wind. The moisture of these winds is obtained from the same inexhaustible source, the ocean.

The warmth of the dry Chinook in Montana and the one described by Mr. Pague occurring west of the Cascades is derived in a different manner. It results from a compression of air descending from a mountain, the moisture of which has been abstracted on the other slope. These winds are of the same nature as the foehn wind of Europe, and by some writers these two terms are used synonymously. The dry Chinook wind is defined by Professor Harrington, formerly chief of the Weather Bureau, as follows: "A warm, dry, westerly or northerly wind occurring on the eastern slopes of the mountains of the northwest, beginning at any hour of the day and continuing from a few hours to several days." Others make the definition somewhat broader. According to them this wind is defined as a warm, dry wind from the southeast, west or northwest when east of the Rocky Mountains, beginning at any hour of the day or night, and continuing from a few hours to several days.

Distribution and Characteristics of Chinook Winds.—The distribution of the Chinook is rather wide. It occurs most frequently in Washington, Oregon, Montana, Idaho, Wyoming and the Dakotas in the United States, and in the region immediately north in the British possessions. There are authentic instances recorded of this wind in Nebraska, Iowa, Minnesota and even Wisconsin. These latter visitations are rare, and the fact of their being genuine Chinooks is questioned. Professor Abbe states that a wind similar to the Chinook makes its appearance east of the Appalachian range. The winds that bring fog, rain or snow to Buffalo, Pittsburg, Knoxville and Chattanooga frequently descend as clear, dry

XUM

winds on the eastern slope. The increase of temperature in these cases is not great.

The dry Chinook is a peculiar one. In the dead of winter it blows down from the mountains and high plateaus, where ice and snow are supposed to predominate, as a hot, dry wind upon the foothills and valleys below. Its effects are striking. The snow at these lower elevations, at first blown hither and thither by the increasing wind velocity, soon becomes moist and heavy under the influence of the blasts of hot air, and in an incredibly short time may entirely disappear. The temperature rises with astonishing rapidity and the whole aspect of nature is transformed. The arrival of the Chinook bears no relation to the shining of the sun, as it comes as frequently in the coldness of the night as in the warmth of midday. It puts in check the boreal blasts of winter and affords a most welcome relief from the monotonous cold and snow characteristic of mountain winters in high latitudes.

Beneficial Influence of Chinook Winds.—The climatic influences of the dry Chinook are important. In the region of its occurrence east of the Rocky Mountains it has, more than any other single cause, a modifying effect on the severity of winter. Were it not for the visitations of this warm, dry wind the vast stock ranges of Montana, Wyoming and the Dakotas would have to be abandoned in the winter, as the cattle and other stock, prevented by the snow from securing access to the nutritious grasses on the plains, would not be able to secure nourishment sufficient to sustain life. According to the testimony of stockmen in this region, the advent of the Chinook at a critical period is often the means of saving their herds, not only from starvation but from freezing. Instinctively the cattle seem to anticipate its coming, and in times of cold and hunger may be seen standing knee-deep in the snow with their heads turned toward the mountains, anxiously awaiting the arrival of relief. Mr. A. B. Coe, voluntary observer of the Weather Bureau at Kipp, Mont., states that were it not for the Chinook wind the northern slope country of Montana would not be habitable, nor could domestic animals survive the winters.

Aside from its temperature, the Chinook bears an important relation to the amount of snow remaining on the ground in the mountains and on the plains at the time of the spring thaws. If the Chinook has been absent, or infrequent in occurrence, the accumulated snow, especially on the plains, is likely to be great. The conditions are then ripe for high spring floods. If frequent visitations of the Chinook have occurred, much of the snow on the plains will have either disappeared through evaporation or been converted into a hardened mass of snow and ice. As ice

it remains a long time unmelted in the ravines and affords an abundant supply of water for the creeks and rivers during the succeeding spring and early summer. In either event the danger from floods from this source is practically eliminated. It might appear at first thought that these hot winds, which so suddenly denude the plains of snow, would themselves cause floods. Such is not generally the case. These winds are intensely dry, having lost their moisture on the other side of the divide. Accordingly, they reach the eastern slope bereft of their original dampness, but possessing a manifold capacity for absorbing moisture from any source available. The melting snow supplies this source, and so rapidly does the evaporation follow that floods caused by the Chinook alone are practically unknown. Mr. Pague states that the influence of the Chinook wind removes great quantities of snow from the foothills and lower mountains during the winter season, and an absence of the Chinook will cause much of the snow that falls in winter to remain unmelted until spring. Such snow packs, hardens, and becomes a greater mass, for each new fall of snow adds to that which has already fallen. He also states that the floods in the Columbia River do not depend so much on the total precipitation of winter as upon the amount of snow in the mountains when the spring thaw begins.

Changes in Temperature Caused by Chinook Winds.—In Montana the approach of the Chinook is marked by a falling barometer. The winds are light, the sky cloudless, and the air clear and cold. The first signs exhibit themselves on the mountain tops, where horizontal streamers of clouds unfurling along the summits afford a sure indication of the approach of the warm air from the region of high pressure beyond. The clouds thus appearing on the mountain tops are followed by cumuli, which, rolled up in huge billowy masses, soon hide the crests of the mountains from the observer in the foothills. The current of air, warming up by compression as it descends, quickly evaporates its own cloud particles, and from this stage downward it warms with great rapidity. As a rule, the Chinook reaches the lower levels with considerable velocity, depending apparently in a large measure on the steepness of the barometric gradient existing between the neighboring areas of high and low pressure. When the gradient is steep the Chinook comes with a rush and a roar, blowing the snow before it. Its velocity is frequently equal to that of a gale. On account of the heat the snow soon settles and melts, and in a few hours becomes compact ice in the ravines, but may entirely disappear in the open. At other times the advent of the Chinook is less violent. The breeze is a gentle one and comes in light puffs, blowing the snow about in

a fantastic manner, as before. Eventually the wind increases in force, but rarely changes its initial direction. It is not an uncommon winter experience, in regions where the Chinook occurs, to retire at night with a temperature well below freezing and several inches of snow on the ground, only to awaken the next morning to discover the snow all gone and the thermometer 40° or higher.

The rate and amount of temperature change vary, the distribution of atmospheric pressure being the controlling factor. A rise of 20° to 40° in ten or fifteen minutes frequently occurs, although the change is not always so great. The table following shows the temperature of the stations named on the mornings of January 9 and 10, 1894, between which periods a Chinook wind prevailed over the territory represented by these stations. The data is taken from the Weather Bureau records.

Changes in Temperature at Weather Bureau Stations during a Chinook Wind.

STATIONS.	Temperature 8 a. m January 9, 1894.	Temperature 8 a. m. January 10, 1894.	Change in 24 hours.
	Degrees Fahr.	Degrees Fahr.	Degrees Fahr
Roseburg, Ore.	34	44	10
Portland, Ore.	34	42	8
Fort Canby, Wash.	38	42	4
Seattle, Wash.	32	40	8
Walla Walla, Wash.	28	46	18
Spokane, Wash.	14	34	20
Helena, Mont.	10	38	28
Miles City, Mont.	—6	40	46
Havre, Mont.	20	32	12
Bismarck, N. D.	—22	32	54

During this period a high pressure with a reading of 30.7 inches was central over Nevada, and a low pressure with a reading of 29.8 inches over northern Montana.

In his report for November, 1896, the section director of the Idaho climate and crop service states that during the latter part of the month the state was visited by a succession of Chinooks which raised the mean temperature above normal and gave everything a spring-like appearance. In many places plowing was begun. The average temperature for the last half of the month was 12° warmer than the first half. In Montana during the same month the temperature rose from 6° to 40° in two hours at Dillon on the 16th; at Red Lodge from 21° to 31° in one hour; at Kipp on the 17th from 11° to 21° in nine minutes, and at Lewiston

on the same date from 10° to 30° in three hours. At Great Falls, Chinook winds blew continuously on the 13th and 14th and up to 12.25 p. m. of the 15th, when a sudden change in temperature, but not in direction of the wind, occurred. The temperature dropped in a few minutes from 44° to 23°, but a few hours later rose to 54°, after which it fell gradually to 19°. These rapid fluctuations, characteristic of the Chinook, are not well understood, but are supposed to be due to the surging back and forth of the currents of cold and warm air.

Conditions Accompanying Some Well-Defined Chinooks.—Following the warm weather of November, 1896, came a series of snowstorms and cold waves of great intensity for the season. The effect on grazing cattle in Montana was especially severe. Thousands of the helpless beasts wandered aimlessly over the hills searching in vain for food and shelter. As the days went by and no relief was afforded, their safety was a question of great moment. No food was obtainable, for the grasses upon which they were wont to subsist lay buried under thirty inches of snow. On the evening of December 1, 1896, the temperature at Kipp, Mont., was −13°. The air was scarcely moving and the sky was clear. Suddenly over the edge of the mountains in the southwest appeared a great bank of black clouds, their outer edges blown into tatters by the wind. In a few minutes a short puff of hot dry air had reached the plains and in the following seven minutes the temperature had risen 34°. The wind increased in velocity to twenty-five miles and the temperature rose to 38°. Within twelve hours every vestige of the thirty inches of snow had disappeared, leaving the hills bare and the plains covered with water.

Chinook winds with temperatures generally above freezing occurred over Washington, Oregon, Idaho, and Montana on December 2, 3 and 4, 1896. These winds were caused by the presence of a high pressure central over Utah and a low area moving along its northern edge. The winds in this instance are reported to have cleared the snow blockades which had closed the railroads and to have removed the snow from the stock ranges. On December 3, the Portland, Ore., forecast official predicted warm Chinook winds for Washington, Oregon and Idaho, a prediction verified by events.

These warm winds do not always closely follow the mountain slopes, but may take a gentler decline and reach the earth at a distance of a hundred or more miles from the base. When this happens, a well-defined Chinook with moderate temperature may be in existence high up on the mountain and farther away on the plains, while between them, near the foot of the mountain, the temperature may be at zero or below. The

XUM

following is an example: At Kipp, Mont., elevation 4,400 feet, on February 13, 1897, at 8.15 p. m., the temperature was 6°, wind northwest, weather clear and seven inches of snow on the ground. Thirty-eight miles away, at Summit, Mont., altitude 5,500 feet, at the same time, the temperature was 39°, with southwest winds and dense clouds. Three feet of snow was on the ground, but melting rapidly. The Chinook had prevailed for thirteen hours, yet had not reached thirty-eight miles below. Two days later the temperature at Kipp rose to 40° in twelve minutes. In many instances on record the weather has been warm and spring-like near the summit of the mountains, while a cold wave has raged in the valleys below. Travelers who cross the Rocky Mountains in Montana in winter often meet with this phenomenon. Mr. E. J. Glass, section director of the Montana climate and crop service, in a paper on the "Chinook Wind" delivered before the convention of weather bureau officials, at Milwaukee, Wis., in August, 1901, cited an instance of an east-bound Northern Pacific passenger train leaving the summit of the pass with weather mild and the temperature above freezing. A half hour later the train had descended into a cold wave where the temperature was −13°. He states that conditions similar to this frequently exist between Helena and a voluntary station a few miles away and of slightly greater elevation. During the coldest weather of the winter of 1898 at Helena, the temperature at the mountain station was about 32°.

On December 4, 1897, an extensive Chinook was recorded. Its influence was felt as far east as Iowa, where the temperature rose suddenly in the night 12° to 14°. On this date the pressure was 30.7 inches over Utah and 29.7 inches over Manitoba, thus creating a strong indraft of air toward the latter place. In this instance the eastward flowing air probably remained close to the ground and did not rise until near the lakes. Similar conditions prevailed on December 29, 1897, temperatures in Minnesota, Iowa and Wisconsin being from 20° to 50° warmer than on the day preceding. At the same time Chinook winds were felt in Washington and Oregon, as well as in the immediate mountain country east of the Continental Divide.

The Weather Bureau records for Havre, Mont., furnish a number of instances of rapid variations in temperature. On December 18, 1898, in the afternoon the temperature was 45°; at 4 the next morning it was 18°. During the next two hours there was a gain in temperature of 6°, and in the following ten minutes a rise of 20°. Half an hour later the temperature fell to 30°, only to bound back to 44° at 7.30 a. m. On March 7, 1900, the temperature at this place rose 31° between midnight and 4 a. m.

It remained stationary until 10.30 a. m., when in three minutes it decreased from 44° to 18°, and twenty minutes later registered 11°. The variations until 3 a. m. the next day were slight, when a rapid rise in less than an hour carried the temperature back to 40°, only to fall again a few hours later to 9°. The wind during this entire period was from the south or southwest. Figures I and II, showing the automatic records taken by the thermographs and barographs at Havre, Mont., and Williston,

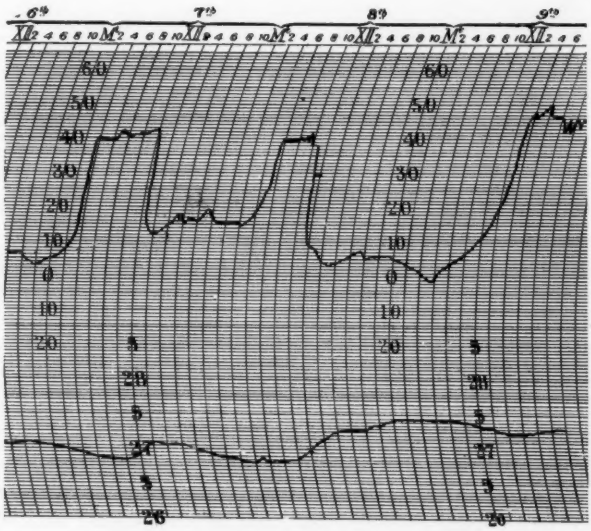


FIG. 1. *Automatic records taken by the thermographs and barographs at Havre, Mont.*

N. D., during this period may give a clearer conception of the facts. The upper lines are the thermograph traces and the lower lines the barograph traces.

Among other dates upon which well-defined Chinooks occurred may be mentioned January 14–18, 1899; December 21–25, 1899, and February 24–25, 1901. Perhaps the instances already given are sufficient to afford a general idea of conditions accompanying a Chinook. It is found by an examination of the weather maps of conditions prevalent at the time of Chinooks that certain barometric relations are usually present. Figure III, which is the weather map for the morning of December 4, 1897, may be taken as a fairly typical representation of the distribution of pressure

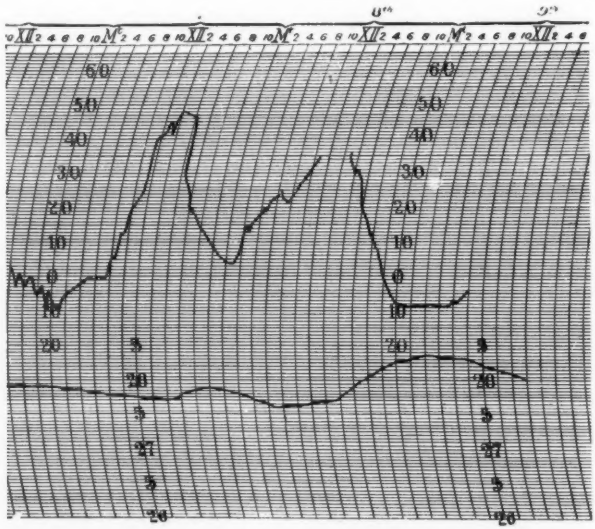


FIG. 2. *Automatic records taken by the thermographs and barographs at Williston, N. D.*

and the resultant winds at such a time. It will be observed that the high pressure, or anti-cyclone, is central over Utah, while the low pressure, or cyclone, is over Manitoba. The air, obeying natural laws, flows from the area of high pressure over the mountains to the low pressure. Emanating from the high plateau region of northern Nevada, Utah and southern Idaho, it flows up and over the ranges to the northward and down the other side. In Oregon and Washington the resultant winds are from the south or southeast, while east of the Rocky Mountains the direction is from the south or southwest. In each case the air reaches a lower elevation than it possessed on the plateau. In doing so it must undergo compression and its temperature is raised accordingly.

Discussion of Conditions Producing Chinooks.—It is a well-established principle of physics that air, if caused to ascend, expands as it rises. As the expansion proceeds heat is used in doing work against the outside pressure, and the temperature is accordingly lowered. This process, known as dynamic cooling, proceeds at a perfectly definite rate, being 1.6° for each 300 feet of ascent, provided no condensation takes place. It is found that the capacity of air to retain vapor diminishes as the temperature is reduced. Ascending air soon reaches a point where its capacity is taxed to the utmost, and if further ascent occurs condensation

takes place and the air current becomes cloudy. This has an important effect on the rate of cooling, as the condensation of water vapor liberates latent heat. The decrease of temperature with ascent is then lowered at a rate depending upon the temperature of the air when condensation commenced and upon the pressure. At a pressure of thirty inches and a temperature of condensation of 10° the fall in temperature is at the rate of 1.2° for each 300 feet; at the same pressure and a temperature of condensation of 30° the rate is 1° for each 300 feet; at a pressure of twenty-two inches and a temperature of condensation of 10° the rate is 1.1° for each 300 feet, and at a temperature of condensation of 30° it is 1° for each 300 feet. At the freezing point, moist air ascends for a short distance without loss of temperature, the energy required to maintain the increased volume being supplied by the latent heat derived from the conversion of water particles into ice. Apply these facts to Chinook winds. Suppose an

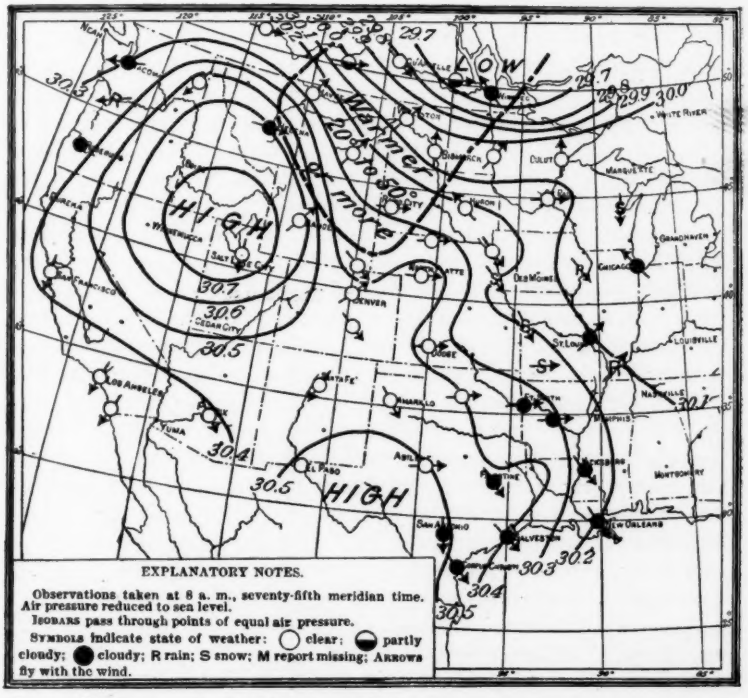

LOW
HIGH
HIGH
Warmer
or more
EXPLANATORY NOTES.
Observations taken at 8 a. m., seventy-fifth meridian time.
Air pressure reduced to sea level.
Isobars pass through points of equal air pressure.
Symbols indicate state of weather: clear; partly cloudy; cloudy; R rain; S snow; M report missing; Arrows fly with the wind.

FIG. 3. *Weather map for December 4, 1897, showing the areas of high and low pressure and the direction of the winds.*

area of high pressure over Montana and the Dakotas, with the temperatures ranging below zero. Let a low area appear off the British Columbia coast and at the same time a second high area move in from the upper California coast. The Dakota storm will move eastward, as will also the low in British Columbia and the high in California, the latter tending to assume a stationary position over Utah, while the low skirts its northern periphery. It is while this movement is in progress that Chinook conditions prevail. Warm, dry air is fed into the low from the high, and this process continues until stronger atmospheric forces break up the combination. This period is not likely to extend, however, beyond two or three days, and may be much less.

The temperature changes that occur in this system are worthy of note. The average temperature of the January highs entering the United States from upper California is about 44°. In passing over the mountains into the region of northern Utah the moisture is precipitated as rain or snow, and the temperature suffers a decrease to about 5° or 10°. The elevation of the plateau country is from 4,000 to 7,000 feet. The Willamette Valley and the Puget Sound region have elevations but slightly above sea level. In the valley of the Columbia the elevation nowhere exceeds 1,000 feet, while east of the Rocky Mountains the elevation gradually decreases from 4,000 to 2,000 feet. The summits of the mountains vary from 5,000 to 8,000 feet. In view of these topographical conditions, the reason for the warm wind down the mountain slopes is apparent. As the air is pushed out of the anti-cyclone toward the low it finds its way blocked on every side. It is literally hemmed in. The downward movement of the air over the center of the anti-cyclone pushes the air out below and compels it to flow up over the mountains, cooling as it goes. The dew point is soon reached, and clouds are formed, followed by snow. As a consequence, when the air reaches the summit of the mountains its temperature is lower, and the absolute amount of moisture it contains is less than before, but it has retained most of the heat evolved by the condensation. In descending the other slope the clouds which were formed on the windward side rapidly dissolve as the temperature rises, and the capacity of the air for moisture consequently increases. In the ascent, on account of the latent heat liberated by condensation, the rate of decrease of temperature is less than the normal rate. In the descent on the other side the dew point of the almost dry air is soon reached and passed. From this point downward the increase is at the normal rate, there being a net gain of about 0.5° for each 300 feet. Thus it will be seen that stations having the same elevation on different sides of a mountain range will have different temperatures, where the air blows from one over the range

to the other. When it is remembered that the eastern half of Montana and the Dakotas is several thousand feet lower than the plateau region where the high pressure is centered, the reason for the warm, dry southwest wind over these states becomes apparent. The contrast is made the greater because of the low temperature existing east of the mountains before the advent of the Chinook.

These Chinooks, therefore, need for their production an area of high pressure and an area of low pressure so located that the winds in being drawn out of the high into the low will be compelled to pass over an intervening mountain range. Owing to the location of the path of the storm tracks, the winter season is the time of the greatest number of Chinooks. During this period the daily chart of reduced pressures shows a tendency of high pressure to pile up over the plateau region. This is known as the continental high of midwinter. Anti-cyclones drifting eastward from the Pacific Ocean along the forty-first parallel become stationary over Utah, where they persist until borne away by a superior high over Montana, or under some circumstances until disintegrated. In summer the storm tracks are different and few high areas pass over Utah. The Chinook winds in the northwestern states are accordingly rare at such a time.

The Southeasterly Chinook Winds.—Two of the winds known as Chinooks have already been described. The third, a southerly or southeasterly wind, west of the Cascade Mountains, is not so generally recognized as a Chinook, and it is only in the last decade that this appellation has been applied to it. It has several of the characteristics of the wet Chinook from the ocean and the dry Chinook farther east. It is described by Mr. Pague in his pamphlet on "Weather Forecasting on the Pacific Coast," and also by Mr. S. M. Blanford in an appendix to that pamphlet. Mr. Pague holds that this wind is originally a dry descending wind, due to the outflow from a high area in Utah. He attributes its high temperature to compression after the moisture has been lost in the plateau regions. The fact that near the ocean it is a wet wind and frequently followed by rain, has led to the assumption that the descending current becomes mixed with the humid air from the ocean. This is hypothetical, and further investigation may yield a different explanation.

The temperature changes accompanying this wind are neither so strong nor so sudden as in the case of the dry Chinook. One reason for this is found in the fact that the winter temperature west of the Cascade Mountains is relatively high and long periods of severely cold weather are rare. However, its effect is not inconsiderable. Mr. Pague, in "The Mild Temperature of the Pacific Northwest and the Influence of the Kuro Shiwo," claims that the influence of this southeasterly Chinook wind has a greater

XUM

effect on the winter climate of the Pacific Northwest than does the adjacent ocean. This view may, perhaps, give undue weight to dynamic heating, as the ocean is thought to be the predominating factor in determining the winter climate of this region. A better understanding of the effect of the Chinook wind on winter weather can be had by considering it divorced from oceanic influences. This is the case east of the Cascade Mountains and in Idaho, Montana and Wyoming. Here the winters are generally severe, broken intermittently by visitations of the Chinook wind.

Conclusion.—As stated in the beginning of this paper, all three Chinook winds possess high temperatures. One is moist and may be followed by rain. It occurs only near the ocean. Another is a dry wind, and rain seldom follows for some time after its occurrence. The third wind occupies an intermediate stage, and, from the present knowledge of it, seems a combination of the two. From November to March these Chinooks play an important part in determining the character of the weather in the northwestern states. They are active agents in tempering the severity of the winter. When they arrive cold waves vanish, the snow disappears, and a short period of bright, balmy spring-like weather ensues. The Chinook aids the railroads in keeping their tracks clear of snow, enables the stockmen to bring their cattle safely through the winter, and stores up water in the form of ice for future use, making irrigation in the summer possible. It is an ever-welcome guest, whose coming is indicative of good, and whose absence would be a momentous evil.

THE EDUCATIONAL VALUE OF GEOGRAPHICAL EXHIBITIONS

BY ALICIA DE RIEMER,
Of the State Normal School, Stevens Point, Wis.

THE expenditure and waste of physical energies peculiar to the individual from infancy are indicative of an innate, compelling desire to "do something." It is the purpose of modern education to present conditions which will make possible some expression of that desire and thus develop power through purposeful self-effort. If that indefinite desire *to do* be directed along lines of least resistance and concentrated interest without crushing or curbing the fresh individuality of the child, a love for a subject will be stimulated that will be abiding and of permanent value.

It is important, therefore, first that the teacher recognize the "philosophy of external energies" and their reflex influence upon the mind; second, that he provide opportunities for self-expression through which the individual may ascertain his own powers and limitations; and third, that he seek especially to direct the child's powers in externalizing individual concepts, thus coördinating hand and brain in the establishment of truth and in the comprehension of the relations controlling life. The science of geography offers a wide field for the exercise of these principles.

The kindergarten, the domestic science laboratory, and the manual training workshop are modern exponents of the principle, *power through self-directed activities*. The introduction of basketry, weaving, chalk-modeling, pottery and other artistic forms of manual training are by no means intended to supplant altogether the necessary fundamentals of education; these simply offer additional avenues for self-expression and supplement the opportunities hitherto presented for purposeful effort. Their strength lies in their power to create, to direct, to develop and possibly to externalize some definite concept. In other words, the manual labor involved in the aforesaid branches unconsciously stimulates the child's interest, strengthens his desires and ultimately leads him *to know himself*.

But, while we are interested in watching the psychological reaction and the educative values of the "new comers" into our school curriculum—fascinating because they appeal to the artistic as well as to the utilitarian phases of interest, let us not be unmindful of the opportunities which the pioneer branches of our course offer—conspicuous among which is the subject of geography.

This study is especially prolific in opportunities for varied forms of expression. Its interests penetrate the heart of a dozen sciences, its field is bounded by the globe itself, its influence pervades the earth-related conditions of society; its applications are universal, its truths fundamental. It offers disciplinary and educative training equal to that of any subject in the curriculum, and its ramifications multiply its possibilities without weakening its unity. Hence, geography stands for opportunity in the broadest sense.

Geography as a *science* demands scientific treatment. Many of its truths admit of formulative, demonstrative and objective reproduction as certainly as do those of physics and chemistry. The ability to make a practical application of a scientific principle tests a pupil's power of adaptation, as well as his thorough understanding of that subject. If that application involves manual labor, brings into play his physical powers, the test is still more severe. A boy who recognizes the earth

XUM

controls of the oil industry, and is able to apply the principles governing a known region to an unknown area, is developing power; if he can correlate with that an ability to construct a model of an oil well to the extent of showing its geographic dependence, he has shown a relative increase in the power which is justified by its semblance to the real, and its relative worth as a production measured by the child's opportunity to acquire the truth.

Allied sciences like biology, chemistry and physics would be lame without the experience of the laboratory; geography is correspondingly weak without similar privileges. But, you say, the field is the great geographical laboratory. True, but during two-thirds of the school year in latitudes north of forty degrees the weather precludes outdoor recitations; hence, something must serve as a substitute. Why not institute a geographical laboratory where work equivalent to that of any other department of science is required—a place for testing facts, for the discovery of values? Here also practice may be had in organizing, tabulating and indexing geographical material. Practice in map representations, hachure, product maps, commercial maps, stereograms, etc., sand and chalk-modeling are made possible. Ingenuity, adaptability, skill, interest, energy, freedom are displayed, individually or compositely here. Nor does this work require a separate room set apart and especially equipped with tools and geographical appliances—though that is a desideratum—but the *work* of the laboratory may be carried on in connection with practically all the departments of the school at free periods, though they should not infringe upon the actual class-room requirements in any department. If a definite laboratory hour is not always possible —the pupils must plan to do the work of the laboratory at convenient times.

Since we are presenting the *active* side of geographic work, it might be well to provide for a definite occasion which will stimulate the students to their best efforts and one in which all may have a share. Such an event may resolve itself into an annual geographic exhibition which, like all exhibits, will prove instructive and valuable in showing the possibilities as well as the extent of production along certain lines, while the contributor gains a valuable insight into the principles which on a larger scale are involved in the reality.

This exhibit may comprise such material as may have been related to the work of the term including physical, commercial or industrial, and mathematical features. Its scope may be greatly increased in some schools so as to embrace correspondingly representative material—such

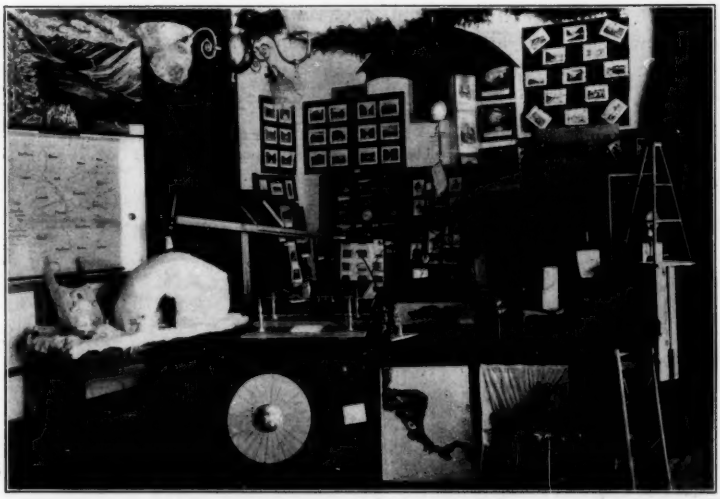


FIG. 1. *Specimens of constructive work prepared for the Geographic Exhibit at the State Normal School of Stevens Point, Wis., January 12 to 16, 1903.*

as physical apparatus, microscopic slides, meteorological instruments, etc.—from the various science departments. Such an alliance, where possible, helps to emphasize the many sidedness of geographic interests.

In Normal Schools the field may be extended still farther by the addition of regular class productions from each of the grades, so that all degrees of material from the primary to the senior grade in the Normal department will have some representation.

The result of such an exhibit in a Normal School from the suggestive point of view is obvious. Its significance in an institution of training is multiplied—for, aside from its value to the individual in giving expression to his concepts, he is likewise gathering a host of suggestive ideas which he as a teacher may have occasion to reproduce subsequently—though perhaps under very different conditions. An exhibit in the grammar grades would necessarily be limited, but the motives actuating the principles realized are quite as evident as in the higher grades. Peoples and their occupations furnish prolific subjects for demonstration along life's related conditions. In mining, for instance, the coal industry makes possible the construction of devices illustrating early methods of obtaining coal compared with those in vogue to-day, thus yoking geography and history. In agriculture, the food products may be represented; as for

XUM

instance by a study of the evolution of the slice of bread from the kernel of wheat, thereby establishing a series of links from the original product, etc. In manufacture, any article of clothing, such as a pair of rubbers or a pocket handkerchief, entails a whole series of activities which will permit of representation. In a similar way, the fishing industry is a fascinating subject for constructive delineation wherein the historical association is involved.

FIG. 2. *Work representing industrial places at the Geographic Exhibit held at the State Normal School, at Stevens Point, Wis.*

In all of the subjects just referred to the nature of the product must necessarily vary. Some children show talents along mechanical lines, others have a decided taste for architecture, others prefer mathematical subjects, and still others will be proficient in artistic expression through the medium of color and form, scissors and paste.

Let us take the fishing industry of the New England States for an example and note the variety of subjects that will admit of reproduction in this one industry alone.

(1) *Early methods of fishing:*

Maps of the region showing distribution of fishing grounds; drawings of local fish types; constructive models of smacks and dories; kinds of tackle; methods of fishing shown by drawings; relief maps of New England

coast, showing nature of harbors; Gloucester harbor; models of fishermen's homes; dress of the fisher folk.

(2) *Modern methods of fishing:*

Models of dock and wharves; modern schooners; tools used in cleaning fish; process of cleaning fish; fishing interests of New England compared by scale with similar interests in Bergen; scale showing relative value of exports; collection of materials made from fish by-products also of sea foods on which fishes subsist; commercial maps, showing routes of transportations and points of destination of fish products; representative manufactures dependent upon fish, viz.: glue, twine, flies, nets, reels, anchors, etc.; photographs showing scenery about Gloucester; illustrated chapters describing some part of the industry or several chapters summing up the subjects discussed in class.

HOW TO PLAN FOR AN EXHIBIT

The extent and scope of the exhibit must be determined by local conditions. The following hints regarding the preliminary steps are practicable and may be suggestive:

First. Take your pupils into your confidence. Discuss with them some weeks in advance the motive and desirability of an exhibit. Appeal to the individual interest and point out the necessity of coöperation. Show the value of all *national* expositions and thus establish the plan on a coöperative, social basis. Be enthusiastic.

Second. Try to discover by personal interviews what kind of work especially interests each pupil. Then if he is handy with tools, talk with him about utilizing that gift by doing some constructive work which will constantly gratify his inclinations and make him appreciate his powers and at the same time develop his ability to adapt and to concentrate. If he is mathematically inclined, try to divert that bent toward developing some mathematical device or representing some proportion such as relative sizes of areas or products, distances or altitudes. His artistic talents will find expression in myriads of ways: map drawing and coloring, chalk modeling, organization of views illustrating type regions, photographs of local regions, etc.

Third. After the subject has been decided upon, make frequent inquiries concerning the progress of the undertaking, show an interest in the effort, and encourage often. Be systematic in the planning and see that the pupils assume their share of responsibility.

Much depends upon the power of the instructor, not alone in creating an interest in the results of individual effort, but also in helping each to

realize the highest possible motives in the effort put forth. The personal pride of the pupil, moreover, which is a natural accompaniment of competition, will still farther stimulate each to his best effort. This should lead to a desire for a wider knowledge of the subject through investigation and research in proportion to the age and experience of the worker.

HOW TO CONDUCT AN EXHIBIT

While a display chiefly concerns the product side, the social aspect of an exhibit is by no means unimportant. In this respect it has been likened to what in higher scientific circles is known as a "Conversazione."

FIG. 3. *Glimpse of the Geographic Exhibit prepared by students of the State Normal School, Stevens Point, Wis.*

If the exhibit is to be open for inspection for several days see that it is well advertised through personal agencies and through the local newspapers, so that it is put upon a dignified basis as an occasion worthy of the attention of the community. When possible it would be well to give illustrated lectures on some topics of general interest and open to the public on certain evenings of the exhibit.

Frequent talks after school hours given by the students and illustrative of different phases of work would be valuable. Five minute talks on the work of the different departments of the United States government are particularly valuable. These may include the work of the Department of Agriculture in preserving forest lands; of the Geological Survey in scientific geology, in map making and in irrigation; of the Weather Bureau in spreading broadly forecasts of the weather and in encouraging the elementary study of the weather in schools.

Actual student demonstrations of sand and pulp modeling and chalk modeling are also helpful.

As far as possible the preparation and management of the exhibition should not infringe upon the regular program of the school. The labor should be so distributed beforehand as to give to as many as possible an opportunity to share the responsibility and to have a definite part in the success of the work. It is also well to give credit to every contributor, without in any way seeming to publish the relative values of the material accepted for the exhibition.

The participation of many pupils in an event which to them represents much thought and time, develops a spirit of coöperation which in itself justifies an undertaking of the character described. Moreover, it encourages a delightful community spirit of social intercourse, which is healthful and commendable among the pupils themselves and a desirable relation between the school and the home. Furthermore, the exhibit can be made the nucleus of a geographical museum which may be enlarged during the year by contributions from distant sections and thereby serve as an incentive to better production among the pupils each succeeding year.

Those who have not tried the plan herein described can little estimate the effect of such work. I know of no experiment which awakens greater interest, reveals more effectively the magnitude and the relations of geography, is more helpful in its suggestiveness, inspires higher aims, brings the pupil into a fuller realization of the subject in its actual dealings with life than just such an exposition.

In short, whatever contributes to the interest, the activities, the growth of the student of geography, in disclosing to him the sequences, the wonderful adjustment, the political and commercial relations which are treated of under the term geography, whether it be in the laboratory, in the field or in the recitation, all such agencies make possible the highest appreciation of the subject as it relates to *life* and awaken in the child an interest which dominates the training which makes for good citizenship.

THE GEOGRAPHY OF LAKE HURON AT KINCARDINE, ONTARIO

An Account of Geographic Features that Result from Uplift in the Process of the Great Lake Tilting

BY PROF. MARK S. W. JEFFERSON,
Of the State Normal School, Ypsilanti, Mich.

KINCARDINE lies about a hundred miles north of Gilbert's isobase, or line of no tilting, on the eastern shore of Lake Huron. With respect to the isobase it is fairly central in the region of uplift and the water seems to recede from shore. With respect to the wind points it lies to leeward and is on the summer resort shore of Lake Huron as far as climate can make it. If it is not to Detroit and Toledo what the west shore of the Lower Peninsula of Michigan is to Chicago, Illinois and Indiana, it is owing to the custom houses that must be passed in going and coming, and attendant circumstances. For transportation, like other business on the great lakes, pays much heed to the international boundary. In German text-books these are still the Canadian lakes as they were to Louis Agassiz, but Canada's part in the activity on the lakes to-day is to sit on the further shore and see the procession go by.

Climatically it has the same mild weather in summer that is Florida's asset in winter. On the Michigan shore the winds come to one across the peninsula, and when the wind has passed on across the seventy miles of lake to Ontario it has lost mosquitoes and caloric. It is not the wind alone that goes to the eastward on Lake Huron. If summer travel checks at the frontier, the waters with all their flotsam are always working over to Canada. When the *Louise* was shaken to pieces off Saginaw Bay last summer by the short lake waves, the remnants came to rest on the beach at Kincardine and northward. The arrows on the map show this drift as worked out from bottle paper studies by N. B. Conger for the Weather Bureau. Mr. Leverett, in his admirable monograph on the Illinois Glacial Lobe, quotes a criticism of these current charts from Prof. Cooley. But if the criticism rests, as it seems to, on the fact that the waters in all the lakes go with stronger winds of the moment, it is no more than happens to all currents. Even the Florida stream, which is one of the most pronounced in the world, is set back by a strong northeast wind. A current means no more than a general tendency. If the waters move to eastward every day but Monday, we must still say this is a current. As our winds

are oftenest westerly, we need not doubt that other winds may have their way with the waters on occasion, but these occasions are exceptional. For sixty days last summer the drift was positive along the shore at Kincardine, as Mr. Conger marks it, to the northward. Logs from the other side systematically sidled along the beach just as they do on the seashore at Marthas Vineyard. Once only in a summer at each place have I seen them come against the "current," when a strong wind set that way. The "current," of course, came with them, but water moving in an exceptional course is not what the word "current" should refer to.

FIG. 1. *General map of the Great Lakes District.*

To look off to that lake horizon reminds a New Englander of the ocean, though sunsets on the water are a novelty. But the same broad expanse of water seems spread out to view. There is a disappointment in the odors, though. While the basin harbors about the lakes often smell quite as fishy as Gloucester, one is perpetually sniffing in vain for the salty air of the ocean. There are other disappointments too for the wayfarer from the seaside. The ocean swell is never seen, the ocean waves never roll in, and many a day goes by before the eye is rewarded that looks lakeward almost in anxiety to see the lake draw back and leave bare the bowlders that just show above the waters. There is a lake swell, though, and a lake tide, all plain enough if you wait to catch them, and waves that have deadly power on things afloat, though they may not reach Atlantic magnitude. Twenty-five times a minute they break on the Kincardine shore, or twelve if you discount the outrush from each comber that in returning turns a little somersault at the foot of the beach on its own account.

FIG. 2. *The Lake Huron shore at Kincardine.*

But the Huron beach is beautiful, and if you miss the salt, it is pleasing to think that all these miles of water are good to drink. The land-waters in this part of the world are somewhat highly charged with minerals from limestone rocks, but the lake waters are admirable.

WHAT ARE THE CHARACTERS OF A SHORE OF UPLIFT?

(1) The waves are always working on new levels of the shore that are rising into their line of play.

(2) The shore features of the past are left high above the present waters.

(3) The streams that enter the lakes have a constantly increasing fall.

Each of these characters finds an opposite in the region south of the isobase, where the shore is settling down in the water. A journey along the western shore of the lower peninsula with these contrasts in mind was amply rewarded.

Hitherto the ancient shore features have been most studied and in these studies originated our knowledge of the tilting of the region. The country

about Kincardine is thickly drift-covered, like southern Michigan, and the till is much the same as that seen in Ypsilanti. Underneath are flat-lying rocks, just as they are across the lake. At one point in the bed of the Penetangore these ledges are revealed above the level of the lake, but on the shores about here they are nowhere visible. The till has fewer boulders than in New England but more than is usual in southern Michigan.

As the rising of the land keeps the lake always at work on new levels of this till, boulders, cobblestones and pebbles are everywhere in evidence. Sand is present only in patches that work their way along the stony shore and blow thinly back into the fir woods that line it.

Figure 2 is a fair sample of one of the more sandy stretches, while at some points the beach is a continuous mass of stones from six inches to a foot in diameter. Under water more than ninety per cent. of the near shore bottom is so stony as to make walking excessively painful, and bathers seek out the sandbars flung up by storms. Large boulders, often tons in weight, strew the bottom further out and constitute a formidable danger to vessels that get too near in shore. They are cousins of the glacial erratics which abound in New England, as they may have done earlier in some parts of the west. But the scarcity of ledges of suitable building stone has sent them mostly into underpinnings and to other structural uses. If similar boulders occur on the bottom south of the isobase, the depression tends to remove them from the danger zone as the uplift causes them to be a menace in the north.

FIG. 3. *Old beach lines at Kincardine.*

Tiny dune ridges, five to ten feet high, wall off the beach at the back with fine grayish sand under overhanging roots of ground juniper and a finer evergreen, known locally as ground hemlock, and overtopped by savins and arbor vitæ with occasional birches and poplars. The supply of sand from the beach is not more than the shore growth has been ample to retain near the water. Only in spots where the evergreens have been thoughtlessly cut away has it drifted and invaded the gardens of the village. Such a clearing is shown in Figure 3. The cobbles of older beaches fifteen feet above the lake have been swept bare by the wind, while in the background the sand is surmounting the bluff to make its only serious invasion of Kincardine property. The bluff that the sands are climbing stood formerly at the shore. The till lies under the sand. Above is the flat on which stands most of the village.

In contrast we may take Muskegon, Mich., on the west shore of the lower peninsula and nearly as far south of the isobase as Kincardine is north. Here the coast is steadily sinking. The sand that the west winds blow back from the lake waves in this century are brought back into wave-play in the next by subsidence. The shore materials are, therefore, thoroughly worked over and ground fine. So there is no pebble in sight here, nor at Holland, nor at Ludington, all similar points south of the isobase along that coast.

Generally it is a low land walled off from the lake by a line of massive

FIG. 4. *Plan of Muskegon Lake, Muskegon, Mich.*

dunes, one or two hundred feet high; a ridge, yet with round-topped sand hills wall-like to east and west and well grown with pines. At Kincardine you go up a slope of wind-driven sand and find yourself on

FIG. 5. *The Lake Michigan shore in Southwest Michigan.*

firm boulder clay. At Muskegon and similar points one climbs a slope of the finest sand only to descend through an equal height on the other side.

There are no elevated beaches of the present lakes here, no beaches of a Lake Michigan that spilled its overflow through Huron and Erie to Niagara.

In the sketch of Muskegon, shown in Figure 4, the pouch-like harbor that characterizes these shores becomes evident. It is a river that is walled off from the lake by a sandbar. The sinking valley admits the waters of the "Big Lake" into the smaller lake, and the west winds pile a wall of sand across the entrance of the bay thus formed, doubtless not directly as it builds the sand hills, for the bar is low and relatively flat, but as on the Marthas Vineyard coast, by setting up the shore drift that works the sands along in the continuous line of the coast. The river water at Muskegon is of sufficient volume to maintain a channel across the bar, which is here, as elsewhere, maintained by dredging and protected by piling, as seen in the picture. To prevent the longshore drift

filling the entrance, piers are here and at all these coast ports built far out into the lake.

The prostrate pine in Figure 5 shows the advance of the dune. When the tree fell its roots rested on the dune. Now the sands that the wind has dug from under its roots are piled upon the crown and hold it in the strange position. For such vessels as can enter the not very deep channel the harbor is a safe one and the city comes down to the wharves on Muskegon Lake.

There is a contrast here in the size of the beach material and in the significance of dune sand. The only point I have visited on that east shore of Lake Michigan which is north of the isobase is Petoskey on Little Traverse Bay. Unlike Kincardine the shore is a bluff of massive limestone, but back of this are the old shores and their bluffs. The beach is, of course, pebbly and stony from the cliffs above. There is no dune sand. Kincardine has a pouch lake too, and a barrier beach across its mouth. But the lake is high and dry, and the sand barrier that once walled it off from Lake Huron is now a low sandy ridge that runs just east of Queen Street, north of Victoria Park, and continues south of the river in the same line to join the bluffs of clay again at C. P. Harvey's, two or three miles to the south. The cemetery is on the ridge and the railroad cutting to the south shows its structure. Queen Street is about seventy feet above Lake Huron.

When Lake Huron stood seventy feet higher or the land seventy feet lower, which comes to the same thing, there was a smaller lake behind the ridge and only a narrow channel connected the two lakes. That channel probably shifted along the line of the bar from year to year as such channels will when not maintained by engineering works. The last place it occupied, however, while the land stood at that low level, was near the present passage of the river, which has deepened the channel as the land has risen and spread its branches finger-like over the whole basin of the inner lake. The channels are deep and narrow because in the history of the world it is so short a time that they have been in process of construction. The stony bed, the caving banks, and the rapid waters east of Queen Street bridge, all point to the young river with its powers increased by uplift, uplift that gives more fall and impetus to its waters. So at Petoskey the planking of the little river bed that rushes down to the bay tells the same story of uplift and renewed energies.

But all this cutting of channels by rapid waters has another side in hastened deposition. In the harbors of southern Michigan that have been referred to, the engineer's task is to dredge away the bar that forms at the

pier entrance far out in the lakes. Mostly the projects for betterment have concerned themselves with getting the piers out into deeper waters like the Eads jetties at the Mississippi mouth. Of deposition within by the rivers that enter the inner lakes there is no talk. Whatever deposition occurs must be far up their drowned valleys, since they are too sluggish in their lower courses to allow any erosion near the lakes. At Kincardine it is different. There was no inner lake there in modern days, but they have dredged out a little basin just within the river mouth and led out

FIG. 6. *Plan of Kincardine, Ontario.*

piers into the lake from it, quite in the style of the Muskegon Lake ports. But the considerable sediment brought down by the rapid waters of the Penetangore constitute a greater source of shoaling than the longshore drift without.

At Goderich, thirty miles further south, where a similar basin was dug out in the river mouth, the expedient has been resorted to of cutting a new outlet for the river to one side to avoid excessive filling of the basin by the active stream. This happened, I understand, within the last few years, but the stream has already pushed forward two long lines of bar, forming a V with the point outward and just out of water, while the river rushes over the shallows on the arms of the letter to right and left.

Contrast with all this activity the accompanying view (Figure 7) of the river mouth at Muskegon. Thus fringed with aquatic plants, winding through meadows, all the southern rivers come to the pouch lakes of their drowned lower courses. So the Black, the Pere Marquette, the Pentwater, to mention only those that I have seen and photographed; and so terminate in the Detroit river and Lake Erie the Rouge, the Raisin and the Huron on the eastern slope of lower Michigan.

I have some admirable views on the Penetangore of Kincardine to contrast with this, showing the broad beds of boulders on which whole trees lie awaiting the freshet waters to move the next step downward, but I must refrain and show instead the last descent of the river, the spot east of the Queen Street bridge where the level of the lake waters is encountered. We are looking down stream. Pebbles and stones show here in the river bed and the steep cut bank shows signs of active erosion, but the interest in this spot is that here are seen reversals of the river flow in time of seiche. Forel used a glass siphon leading to a little basin at the foot of his garden at Morges on Lake Geneva* to show minor fluctuations in the lake level. Rising levels sent the water into his tank through the tube while the fall of water without reversed the current. Thus by studying the motion of floats within the tube he was able to detect oscillations of the lake waters otherwise quite invisible.

Dr. Martyn, of Kincardine, first called my attention to the reversal of the current at this point on the river. As he expressed it the river alternates up and down every twenty minutes. A workman who had been

FIG. 7. *Black River, Muskegon.*

*G. H. Darwin. Tides, p. 17 et seq.

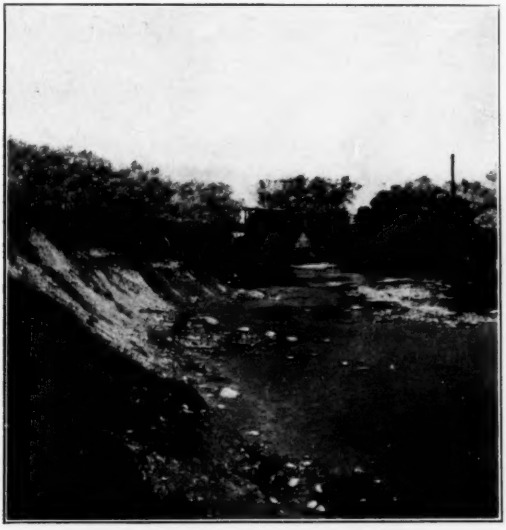


FIG. 8. *Penetangore River, Kincardine.*

engaged in some work on a raft beneath the bridge told a similar story, how their float would first edge up stream and then after a time pull again in the opposite direction, as the river might be expected to. I first visited the spot August 27, 1902, at 9.55 a. m. From the bridge there was only a slight drift upstream visible. At 10.12 there seemed to be a stand, but the water presently started up again. At 10.20 it was still upstream and I was obliged to leave. On this day there was some wind on shore and a few white caps visible on the lake. The river is flowing continuously as one may see a little further upstream, though it is little more than a big brook in dry weather. September first I saw the phenomenon more definitely. The day was calm after a violent, cold northwest wind that was blowing in the night and left good-sized waves still running in the morning. When I came to the spot photographed it was 11 h. 27 m. 30 s. The river was running down, the water was nowhere so much as six inches deep and was running down from bank to bank and from top to bottom. At 30 m. 30 s. it started running upstream, then checked, stood still and at 33 m. 30 s. went down fast, running in ripples; at 36 m. 0 s. it was rippling noisily, at 40 m. 0 s. it was slowing up, at 41 m. 30 s. it stood still, at 42 m. it was going up, at 51 m. came the turn and start down, at 59 m.

another turn, but at 59 m. 30 s. it was going down again. At 12 h. 0 m. the water was still, and at 12 h. 0 m. 30 s. down again; at 12 h. 12 m. 30 s. came another stand and the start upstream.

In the three-quarters of an hour the observations lasted the first and last movements were not seen completed, but the directions and periods observed were as follows: down 5 minutes, pause 1 minute; down 8 minutes; up 9½ minutes; down 8 minutes, pause 1 minute; down 12 minutes, suggesting a seichal oscillation belonging by its period rather to the Kincardine basin than the whole width of Lake Huron and showing a curious check at midfall of the water. I do not know whether such oscillation is detected at Goderich.

As the till yields with comparative rapidity to the swift streams, abundantly armed as they are with pebbles and boulders, the feature of the old lake basin is the striking youth of the valleys. Newberry tells how the Colorado canyon becomes visible suddenly in what a few steps back was an extensive plain.

Two views near the same spot on the river but looking south across it show the same features that are characteristic of Kincardine landscapes. In the first only the plunging fence on the right indicates a valley ahead. To be sure, close examination shows that the trees to right and left stop

FIG. 9. *Victoria Street, Kincardine.*

FIG. 10. *Victoria Street, one hundred steps farther south.*

suddenly, only to be resumed in the distance where the road between is a notch on the middle horizon. The second view is taken from a spot just one hundred steps further south, but with the same horizon line it shows the whole intervening valley of the river. The upper level is approximately the level of the elevated lake bed.

A CURIOUS SALT POND IN KANSAS

BY GEORGE B. HOLLISTER,
Of the United States Geological Survey, Washington, D. C.

ON the line of the famous Jones and Plummer cattle trail, in southwestern Kansas, is located the Meade Salt Well, one of the natural curiosities of the great plains region. It is a depression in the level plain over 200 feet in diameter at the surface and deep enough to completely hide a good-sized house. The sudden appearance of this so-called well is a matter of history. On the 3rd of March, 1879, a wagon passed over the spot on level ground, where the depression now is, but when the place was next seen on the 26th of the same month, a great section of ground was found to have sunk and the hole partially filled with water from an underground source; the wagon tracks were still plainly visible on each side of the cavity. Near by on the east upon the uplands

formerly ran the overland cattle train from northern Texas to Dodge, Kans. A mile or more to the south a branch from this route, which in those years was much traveled, passed into the shallow valley, where the well is located, for over-night camping. The trail lead directly across the present site of the sink hole and to-day the curious sight is presented of road ruts and cattle trails, still discernible, sharply terminating at either edge of the well. Thus in this thinly settled country the spot lay literally in the very path of travel. (See Fig. 1 frontispiece, page 114.)

There are a number of unusual features about the sink which make it of particular interest. One is that the water found in it is decidedly saline, although the ground water in the neighborhood wells has no trace of salt whatever. Another interesting feature is that this strongly saline water at times has a high temperature, according to report close to the boiling point. Neither the saltness nor the high temperature of the water have been satisfactorily explained. Still another very curious peculiarity is the stratification of the water in the depression, that is, its arrangement in layers according to the density of the salt solution. There were found to be two distinct layers of water, that on top which was three feet in depth and one below six feet in depth and extending to the bottom. The top layer contained one-third less salt per unit of volume than the under layer. This interesting fact was discovered by observing the water-logged twigs and grass stems which had been blown by the wind. In time they had sunk through the comparatively fresh and lighter water,

FIG. 2. *The edge of the Salt Well.*

FIG. 3. *A close view of the Salt Well.*

but hung suspended at a uniform level in the lower nearly saturated solution.

Shortly after the sink was discovered, the sides were seen to be gradually settling, and large circular sod cracks developed about the edges. This movement of the surrounding earth had the effect of widening the sides of the depression which now measure 216 feet across the top, 126 feet across the surface of the pond, which is nine feet deep, and about forty feet from the bottom of the water to the level of the plain. The accompanying views, which are taken from a recent report by Willard D. Johnson, of the United States Geological Survey, clearly show the prominent features of this unique formation; its circular form, its great sod cracks and the cattle trails which formerly crossed it.

While the Meade Salt Well is perhaps the most striking of the Kansas sinks, there are many other depressions of similar nature to be found in the state. Large sections of the high plains, which stretch across the western part of Kansas, are fairly pitted with larger or smaller saucer-like depressions, sometimes so near together that a stone can be thrown from one to the other, or with deeper sinks like that near Meade. So numerous are these depressions that their use for the storage of spring rains has

been seriously considered. If they could be put to practical use in this way it would be of the greatest value, as water is the one thing needed for that wonderfully rich but fatally dry region.

How these sinks form, for they are forming constantly and gradually lowering the surface over large areas, is not yet fully determined. But from a recent study of them made by the United States Geological Survey in its investigation of the water supply of the Great Plains, it is thought that the settling is due, in the smaller cases, to a gradual compacting of the ground particles by the percolation of water which collects from rain in particular spots, and by the chemical solution and washing away of the more soluble particles which compose the ground. In the larger sinks which appear suddenly like the Meade Salt Well, there seems to have been a caving in of the underlying rock bed which is thin in places and has probably been decomposed and carried away by the underground waters.

GEOGRAPHICAL NOTES

A School Journey in Algeria.—The January number of the *Revue Pedagogique* contains an interesting account of a school journey of a novel sort in Algeria.

A "special section" is formed in the Normal School of Algiers for the French teachers who are preparing to teach the natives. It is a one-year course. In May the students of this section, together with the principal of the Normal School, make a journey about the country, visiting their predecessors who are at work among the natives, getting acquainted with the purposes entertained and results accomplished.

Such a journey of inspection is reported in the article. The teachers are represented as centers of civilization, teaching the natives how to prepare and cultivate the ground advantageously and working earnestly to instill higher ideas of duty and honor than prevail. The introduction of new trees and vegetables, the teaching of grafting, irrigation, manuring and land surveying of a simple sort, tend to make the graduates of the schools at once useful in their communities. In general, the teachers seem to acquire social influence in their neighborhood, and the teacher's stereopticon lecture is shown us as following the call to prayers with an attendance of old and young to see the pictures of France and French things. It is found necessary to dwell much on this theme among

a people whose older members still believe the Sultan at Constantinople to be the Ruling Monarch of the world, to whom the great powers pay tribute, and from whose workshops in Constantinople they obtain their ships and weapons!

The school seems to be much appreciated by the natives, who in one case, where a school lacked the customary garden, clubbed together and bought ground for it themselves.

"The French teachers among the Kabyles inspire respect by the dignity of their lives and the uprightness of their dealings. They draw sympathy by the varied services they succeed in rendering. They have become the trusted leaders of the natives, often their confidants and sometimes their bankers. The peddlers, the ex-pupils who trade in the Arab country, in Tunis, in France, England, America, and even in Australia, when they have money to send to their relatives, address it to the *sheik*, as they call the French teachers, confident that it will reach its destination.

It is not rash to claim that the French teacher is an important factor in the economic transformation that is going on among the Kabyles, especially among the richer tribes like the Beni-Yenni. The houses are being built with windows and chimneys, more furniture is made, more care taken of clothing, the sewing machine is no longer a rarity, and we saw a jeweler's shop at Ait-Larba lighted with acetylene! Methods of manufacturing jewels, weapons and Kabyle toys are improving, and agriculture is everywhere making progress."

The effect of such a tour, with the opportunity of inspecting the work of their colleagues, must be very advantageous for the Normal students, and France seems to be striking out an admirable method of dealing with a conquered race that has hitherto proved very troublesome.

M. S. W. J.

Current Articles on Commerce and Industry:

Agriculture, *Success*, February.
Alaska, Opening of (Illus.); *Eng. Mag.*, February.
Alps, Industrial Value of (Abstract); *Rev. of Revs.*, February.
Brazil, Cotton Industry of; *Crop Reporter*, January.
Briquette, Machinery, German (Illus.); *Consular Rept.*, February.
California, Forests of; *Miss. Valley Lumberman*, February 6.
Cement, Am.; *Eng. and. Mining Journal*, February 14.
China, Why is it Poor; *Bradstreet's*, February 14.
Coal Deposits of the N. W. (Illus.); *Rev. of Revs.*, February.
Coal Storage, Diversity of Uses (Illus.); *Sci. Am. Supp.*, January 24.

XUM

Cuba, Railroad Development in (Illus.); *Sci. Am.*, January 24.
Erie Canal, Proposed Improvements (Illus.); *Sci. Am. Supp.*, January 17.
Florida Camping, Pleasures of (Illus.); *Country Life*, February.
Germany To-day; *World To-day*, February.
Germany, Commerce and Industry of, in 1901; *Consular Rept.*, January.
Glove Industry in the U. S.; *Sci. Am. Supp.*, January 24.
Grain Unloading Elevator (Illus.); *Sci. Am.*, January 31.
India, Commercial, in 1902; *Monthly Summary of Comm. and Finance*, December, 1902.
Ireland's Emancipation (Illus.); *Rev. of Revs.*, February.
Irrigation (Illus.); *Sci. Am. Supp.*, January 10 and 17.
Lignites of N. D. (Illus.); *Eng. and Mining Journal*, February 7.
Mexico of To-day (Illus.); *World To-day*, February.
Mountain Water Powers, Utilization of (Illus.); *Eng. Mag.*, February.
Nile Dam, Opening of (Illus.); *Sci. Am. Supp.*, January 10.
Oleomargarine Mfg. (Illus.); *Sci. Am. Supp.*, January 3.
Orange in Florida and California (Illus.); *Country Life*, February.
Pacific Cables (Illus.); *Rev. of Revs.*, February.
Power, Tendencies in Utilization of; *Sci. Am. Supp.*, January 24 and 31.
Power Supply of Future; *Textile Record*, February.
Quarries of Sandstone in Ohio; *Sci. Am.*, February 14.
Rice, Consumption of; *Bradstreet's*, January 31.
Salt, Evaporated Salt Industry of Kansas (Illus.); *Eng. and Mining Journal*, February 7.
Shoe Mfg. of the U. S. (Illus.); *Success*, February.
Siberian Railway, Traveling on; *Consular Rept.*, February.
Soap Mfg. and Use in Textile Industries; *Textile Record*, February.
Sponges, Where They Live, How Obtained and Used; *Sci. Am. Supp.*, February 14.
Standard Oil Co., History of, Ch. IV (Illus.); *McClure's*, February.
Steamships, History of; *Sci. Am. Supp.*, February 14.
Wireless Telegraphy (Illus.); *Rev. of Revs.*, February.
Wool (continued); *Textile Record*, February.

EDITORIAL

THE ATLAS AND ENCYCLOPEDIA HABIT

HOW many teachers and readers of geography, history or current events have the atlas and encyclopedia habit as strongly as could be desired? Is it not true that a large majority of readers will follow the details of a campaign in Caesar's Gallic War, or the progress of the Emperor William to Jerusalem, or any other event that has a geographic background, without ever referring to any more accurate map than the somewhat hazy and elusive outline that is one of their indistinct visual images?

Not only history, geography and current events, but even fiction often needs a map as a companion if the reader is to gather the best from his reading. The best read men, and those who hold their facts in such an ordered form that they are always serviceable, are the men who look up every important place in an atlas, and who seek an encyclopedia for the additional information necessary for the understanding of current events.

The habit of interrupting one's reading to consult a reference volume is hard to cultivate, because it seems to break the continuity of thought. Yet this is the only way of acquiring the habit, and through the habit, the knowledge that makes for general culture. In the course of time the atlas or encyclopedia is only sought for the uncommon fact, just as there comes a time in reading a foreign language when the dictionary is only used occasionally. No student of French or German would think of getting along without a dictionary. In his reading the dictionary would be at his side, and his hand would reach for it involuntarily, as the eye caught the first glimpse of the unfamiliar word and construction. In the same way all readers in geographical lines should feel lonely without the comforting companionship of a faithful encyclopedia and atlas. Every one should drill himself in the habit until it is ingrained, and all teachers should train their pupils to use all kinds of reference volumes. The best training from school geography is that which leaves the pupil able to seek and use geographical information and to separate the true from the untrue. This training can only come through constant study of the map and the encyclopedia. It is true that drill work on maps may kill interest in geography, but that is because it is introduced at the wrong time or because the facts are given as individual tasks for discipline only. In the higher grades is the best place for training in the use of reference books,

because there the proper emphasis can be placed on relations between facts.

We should also remember that a good map is the most accurate representation of a region we can get. Words, however pleasingly joined, in the descriptions of a traveler cannot give as clear cut a picture of a region as can a map. A map gives only the facts so far as they are known to all students and is not biased in its presentation. It speaks for all men and not for an individual. Hence a map should be sought before an encyclopedia or a descriptive text in most cases where such books of reference are needed.

There is no better habit to form than the atlas and encyclopedia habit, which is ingrained in all students of geography, and which deserves exploitation by all teachers of geography, or of any subject that deals with the relative distribution of phenomena in the world.

REVIEWS

The New England States. By Philip Emerson. Size, 7 x 5¼. Pp. viii and 128. Supplementary volume to Tarr & McMurry's Geographies. The Macmillan Company, 1901.

Emerson's volume on the New England States is selected for review because it is the best of the several volumes that have appeared as supplements to the Tarr & McMurry Geographies. The order is logically progressive, and proper emphasis is constantly given to the relation between social and industrial conditions and physiographic facts. The author has a wealth of well ordered facts at his control and has shown great ability in weaving them together into a readable and appealing text. The book is well illustrated and the cuts are reproduced effectively. An appendix contains such statistical facts as may be needed for use in schools.

The chapters on industries, pp. 33–66, deal with the details of fishing, lumbering, agriculture, quarrying, textile manufactures, shoe manufactures, manufactures of metals, and commerce. These chapters are very complete, clear in statement, and are valuable to all who have to deal with the technique of industries.

The last fifty pages of the book are devoted to the general geography of the several states, treated in the order of their economic importance. The different states, except Vermont and Maine, are treated by physiographic divisions, but in some instances closer relation could have been shown between the physiography and the general geography.

As a whole, the book is useful as a supplementary volume, both in New England and without, and is to be commended strongly. It lacks the spirit of advertising and the curt gazeteer tone of so many supplementary volumes, and can be read with pleasure, rather than as a task. The author has set a standard that his colleagues in the series will do well to emulate R. E. D.

Home Geography for Primary Grades. By Harold W. Fairbanks. Size, 7¼ x 6½. Pp. 236. Illustrations and maps, 134. Educational Publishing Company, Boston, 1902.

In "Home Geography for Primary Grades" the author has attempted the difficult task of putting in readable form for little children a discussion of the elements of geographical knowledge.

On the whole, the work is successfully done. It is generally accurate, the subjects are presented in an interesting manner, and the style is simple enough to make the topics comprehensible to a very young child. It would seem on the whole rather better adapted to pupils of the third year, however, than to fourth year classes, for whom it is primarily intended.

In many of our primary texts the adaptation of the subject to the child has been made with so great an effort on the part of the author that it is at once apparent in a forced style. The reader under consideration is not entirely free from this fault, though it is not of frequent occurrence. "By and by we shall grow up and become men and women. . . . The world will be our happy home," is a typical illustration of a style which fortunately fails to commend itself to the dignity of every well regulated fourth, or indeed third, year boy and girl.

The book covers a broad field, discussing for the most part soil, climate, the atmosphere, the surface of the earth, the ocean, rivers, forms of land and water, animal and vegetable life and occupations.

Much of the material presented is drawn from the child's immediate environment. In so far as this is the case, with the exception of a few chapters which are purely biological, the book is certainly what it claims to be—a "home geography." All of the subjects treated, however, do not fall in this category; in order that the book should conform to the title, an occasional chapter should have been omitted, and in other cases the bearing of the subject upon the home should have been shown.

The illustrations are well chosen, but for the most part are poorly reproduced.

On the whole, the defects of the book are not serious ones and are largely atoned for by its strong features. C. B. K

RECENT PUBLICATIONS

Eskimo Stories. By Mary E. E. Smith. Pp. 189. Chicago: Rand, McNally & Co., 1902.

A well illustrated and artistic volume for supplementary reading in the earlier grades.

Man and His Work, an Introduction to Human Geography. By A. J. and F D. Herbertsen. Pp. 136. London: Adam and Charles Black, 1902.

An illustrated edition of a small book on human geography that should be in the hands of every teacher of geography.

Triumphs of Science. Edited by M. A. L. Lane. Pp. 154; volume in Youth's Companion Series. Boston: Ginn & Co., 1903.

Selected articles, usually by recognized authorities, dealing with interesting discoveries of modern times. Several chapters are geographical and valuable for supplementary reading in intermediate grades.

XUM

NEWS NOTES

The Geographical Association of Great Britain held its annual meeting in January, and received very satisfactory reports of the year's work from the several officers. As has been frequently stated in this JOURNAL, the object of the Association is to promote the betterment of geography teaching in the schools of the United Kingdom. The *Journal of School Geography*, one of the predecessors of this JOURNAL, was for several years sent by the Association at reduced rates to such of its members as desired it. In 1902 the Association established a quarterly known as the *Geographical Teacher*. The paper will hereafter be edited by Dr. A. J. Herbertson, one of the associate editors of the JOURNAL OF GEOGRAPHY. The *Geographical Teacher* contains many very helpful and practical articles and reviews. The JOURNAL OF GEOGRAPHY will continue to reprint pertinent articles from the *Geographical Teacher* from time to time. The *Geographical Teacher* should, however, be in the library of every normal school of the country, and will be found valuable to all progressive teachers in the higher grades. Those desiring to secure the *Geographical Teacher* should correspond with Dr. A. J. Herbertson, 49 Staverton Road, Oxford, England, or with Professor Dodge.

Geography in the University of Chicago.—The University of Chicago has established a Department of Geography, and Professor Rollin D. Salisbury, of the Department of Geology, has been placed at its head. The arrangement between the Departments of Geology and Geography is such that Professor Salisbury retains his connection with the former, as heretofore, at the same time that he assumes the headship of the latter. The close connection of the two departments appears from the fact that Professor Salisbury will also act as head of the Department of Geology when Professor Chamberlain is not in residence, and Professor Chamberlain will act as head of the Department of Geography in Professor Salisbury's absence.

The Department of Geology has heretofore offered courses, both elementary and advanced, in Physical Geography, and elementary courses in Meteorology. Other courses of a geographic character have been offered by other departments, notably Geographic Botany by the Department of Botany, Zoögeography by the Department of Zoölogy, and Commercial Geography by the Department of Political Economy. These courses will continue to be given, as heretofore, by these several

departments, except that of Meteorology which will be under the auspices the new Department. The new department will not duplicate the geographic courses already given, but will, at the outset, provide courses which supplement those already established. The immediate aim will be to occupy the ground intermediate between Geology and Climatology on the one hand, and History, Sociology, Political Economy and Biology on the other. The courses offered at the outset will be those for which, within this field, there is greatest demand.

John Paul Goode, Ph. D., in charge of the work of Geography in the Wharton School in the University of Pennsylvania, has accepted an Assistant Professorship in the Department of Geography, and will begin his work the second term of the Summer Quarter (July 27, 1903). No other appointment will be made this year. The courses which he will give during the first year will include courses on the Economic Geography of (1) North America, (2) Europe and (3) Tropical Countries. The central theme of these courses will be the influence of the physiography, the climate, and the natural resources of these lands on their settlement, development, and present commercial and industrial status. Research courses will also be offered for advanced students.

THE JOURNAL OF GEOGRAPHY

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National Educational Association Number

The JOURNAL *of* GEOGRAPHY

The June number of THE JOURNAL OF GEOGRAPHY will be a National Educational Association number. It will be devoted entirely to

THE GEOGRAPHY OF BOSTON

AND VICINITY

And will be of interest to all who expect to attend the meeting of the National Educational Association in July, 1903, as well as to all Boston and Massachusetts people. This number can be used as a supplementary reader in geography in all New England schools.

Among the numerous articles that may be expected are the following:

THE GENERAL GEOGRAPHY OF BOSTON AND VICINITY
By PROFESSOR GEORGE H. BARTON, *President of the Appalachian Mountain Club*

THE COMMERCIAL GEOGRAPHY OF BOSTON
By PHILIP EMERSON, *of the Cobbett School, Lynn, Mass.*

GEOGRAPHIC EXCURSIONS ABOUT BOSTON
By CHARLES F. KING, *of the Dearborn School, Boston, Mass.*

THE PARK SYSTEM OF BOSTON
By ARTHUR A. SHURTLEFF, *of Boston, Mass.*

THE GEOGRAPHICAL DEVELOPMENT OF BOSTON
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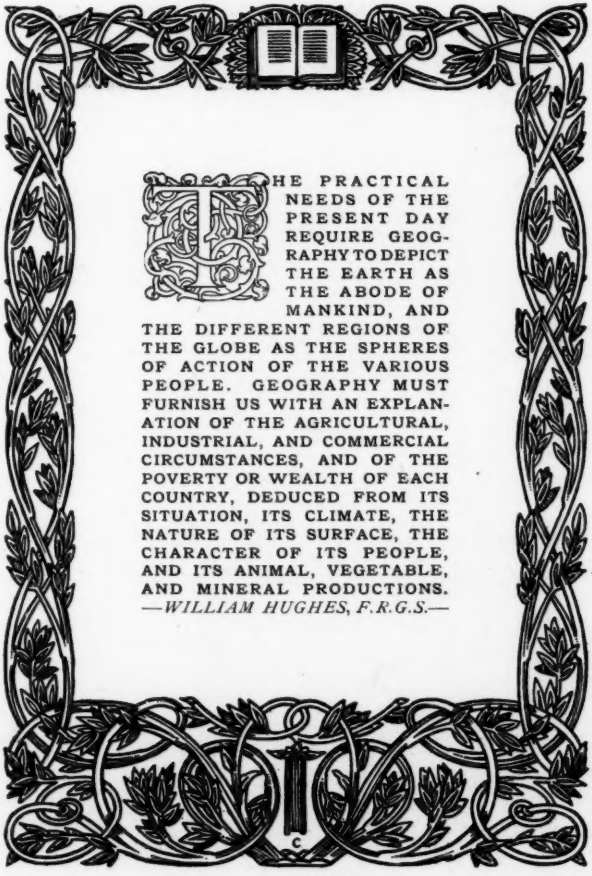

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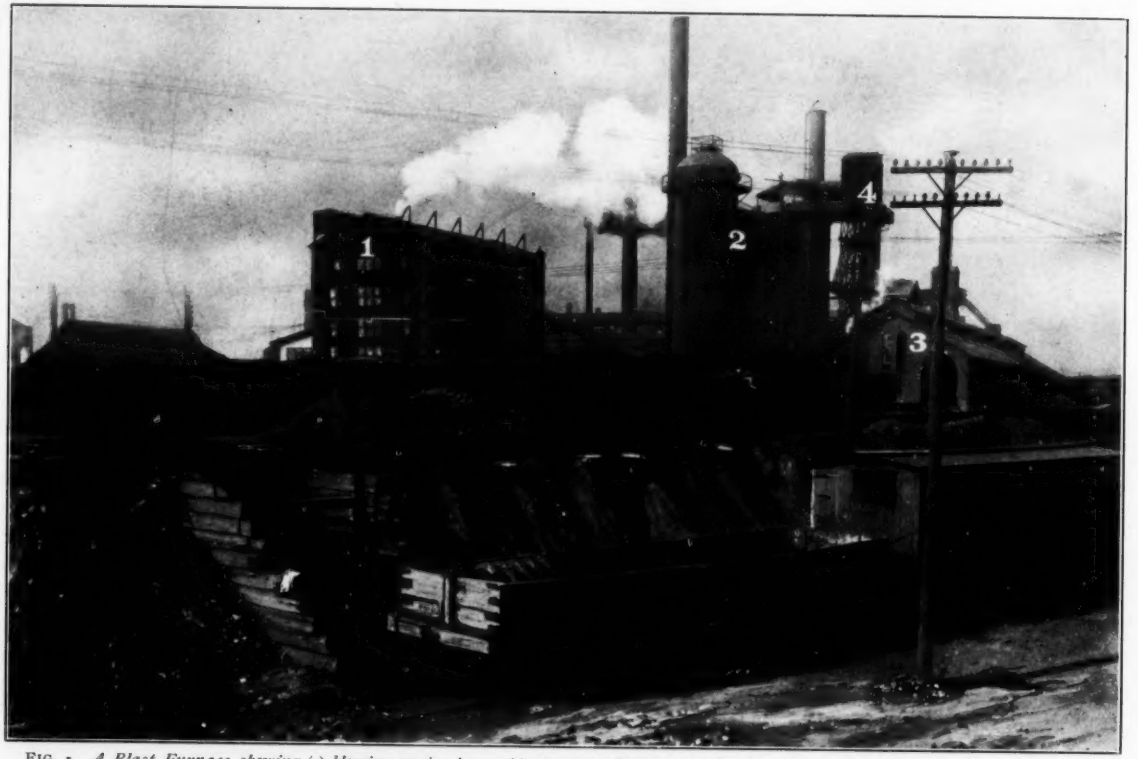

FIG. 1. *A Blast Furnace, showing* (1) *blowing engine house,* (2) *stoves,* (3) *furnace,* (4) *elevator, etc., of the Pennsylvania Steel Company, Steelton, Pa.* *(See article by F. V. Emerson, page 169.)*